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ABSTRACT

A comparison of three approaches to problem solving in fourth grade mathematics is presented. Three classes participated in the study. Class One studied problem solving in a structured classroom setting, Class Two studied problem solving incidentally, and Class Three studied problem solving when it appeared in the text. The structured study of Class One included daily study of a problem solving strategy. The results of the study indicate that problem solving strategies need to be taught in order for children to be able to use them in a consistent and purposeful way. Thought needs to be given to whether or not daily exposure to problem solving experienced by Class One was a major factor in the marked improvement in student scores. (PK)

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Problem Solving Skills of Selected Fourth Grades

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Procedure:

Three fourth grade classes participated in the study. The classes were heterogenous; placement in each class was random. The classes were selected by the researcher; each class was different in approach to problem solving. One class, named Class One in this paper, studied problem solving in a structured classroom setting. Class Two studied problem solving incidentally. Class Three studied problem solving when it appeared in the child's text. This is to say, Class One spent time each day studying a strategy of problem solving. The strategies were, namely: guess and check, draw a picture, make a list, make a table, work backwards, look for a pattern, logical reasoning. The strategies were those listed in the child's textbook as appropriate for grades four.

Class One selected a problem from a problem activities book designed to accompany their text. The problem was presented, children worked in groups, each group sought ways to solve the problem. On the second day the class worked as individuals, each seeking a solution to the problem. The teacher guided the students as they sought answers. The teacher followed:

(1) Understand the problem.

(2) Develop and carry out a plan.

(3) Find the answer and check.

Class Two took the approach in which the teacher presented a problem to the class and each student sought the answer. The problem may or may not have been representative of the seven strategies. The problems presented were "real life" problems encountered during a school day.

Class Three followed the child's textbook page by page. There was no effort on the part of the teacher to teach problem solving using the seven strategies. A strategy may have or may not have been used to solve a textbook problem; teacher directed the process. The problem was presented to the total class; each child worked on their own.

Each of the three classes were given the same pre-test and the same post-test. The items were those that appeared in a problem solving activities booklet which accompanied the child's text. The first item in each of the seven strategies was selected for the pre-test. The post-test included the last problem from each strategy as presented in the problem activities booklet that accompanied the child's text. The problems on the test were not ordered.

Chart I records the findings of Class One. The pre-test and post-test are recorded for each category. (See Appendix p. 1)

Class One showed improvement in four of the seven categories as the result of directed instruction. After the pre-test each child that scored in logical reasoning strategy was interviewed by the researcher. The same problem used on the pre-test was read to the child. The child was asked to solve the problem without any suggestions or hints from the problem.

Six students solved the problem without hints. This is to say six of the seventeen students that solved the problem designed for logical reasoning could solve the problem with no hints provided. Eleven children could not solve the problem when no hints were provided. The hints given in the logical reasoning pre-test example may or may not have attributed to the number of students doing better on the pre-test than the post-test.

Chart II records the findings of Class Two. The pre-test and post-test scores are recorded for each category. (see Appendix p. 2).

Chart II shows children demonstrated little or no improvement in problem solving strategies when problem solving was taught incidentally. In three of the seven strategies there was improvement. The small number demonstrating the strategy changed little when compared to the total class (N).

Chart III records the findings of Class Three. The pre-test and post-test scores are recorded for each category. (see Appendix 3).

Children in Class Three show improvement in two strategies, draw a picture and make a list. There was a low number of children demonstrating problem solving strategies on the post-test. One of twenty children demonstrated the ability to work backwards. No child demonstrated the ability to see a pattern. Two children demonstrated the ability to construct a table on the pre-test. The same one demonstrated the ability to construct a table on the post-test.

Chart IV compares the pre-test scores of the classes. Each strategy shows the number of correct answers per class in percent. (see Appendix p. 4)

Chart IV shows less than half the students in any of the three classes have the ability to use five of the seven strategies as measured by the pre-test. Class One demonstrated the ability to guess and check and use logical reasoning at the 50% level or better. Class Two demonstrated the ability to guess and check significantly better than Class One and Three. Class Three demonstrated the ability to do logical reasoning as measured on the pre-test.

Chart V compares the post-test scores of the three classes. Each strategy shows the number of correct answers expressed in percent. (see Appendix p. 5).

Chart V shows Class One has higher scores in four of the seven strategies than when tested with the pre-test. Class Two showed gains in scores on draw a picture, make a list, and work backwards strategies. No student demonstrated the ability to see patterns on the pre-test or the post-test. Class Three showed gains on the post-test with draw a picture and make a list strategies. The number of students demonstrating problem solving strategies to solve a problem went down in six of the seven categories.

Chart VI (see Appendix p. 6) presents the results of Class One in relation to the percentage of students who were able to use the problem

solving strategies. The students show a -32% improvement in using the guess and check strategy; a 40% improvement in drawing pictures; a 42% and 85% improvement in making a list and table, respectively; a 32% improvement in working backwards; a -32% and -24% improvement in finding patterns and using logical reasoning respectively. In all, over half the class was able to use 4 of the 7 problem solving strategies.

Chart VII (see Appendix p. 7) shows the pre-test/post-test percentage of students in Class Two who were able to use the problem solving strategies. Negative improvement was found in using guess and check (-42%) and making a table (-30%) with no gain in looking for patterns. Improvement was shown in drawing a picture (+26%), making a list (+10%), working backwards (+16%), and logical reasoning (+2%). However, the majority of the class did not master the use of any of the problem solving strategies.

Chart VIII (see Appendix 8) compares the pre-test/post-test percentage of students in Class Three who were able to use problem solving strategies. The results are inconsistent and diverse. The majority of students (65%) were able to successfully use "making a list" as a problem solving strategy with less than half (40%) being able to draw a picture. In all the other problem solving strategies the class has a negative improvement: guess and check -5%, make a table -30%, work backwards -10%, logical reasoning -35% with no gain or loss in finding a pattern. In all, only one problem solving strategy in 7 was mastered by half of the class;

where as, the six strategies were consistently lower in their usage by Class Three compared to Class One and Class Two.

Conclusions

The results of the study seem to reveal that problem solving strategies need to be taught in order for children to be able to use them in a consistent and purposeful way. Thought needs to be given as to whether or not the daily exposure to problem solving experienced by Class One was a major factor in the marked improvement in student scores. It could also be questioned as to whether or not Class One was predisposed to problem solving before the study that influenced their "readiness" ability to understood problem solving strategies.

Chart I

PROCESS PROBLEMS

(Purposeful process instruction)

N 28	GUESS & CHECK		DRAW A PICTURE		MAKE A LIST		MAKE A TABLE		WORK BACKWARDS		LOOK FOR A PATTERN		LOGICAL REASONING	
STUDENTS	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
M.V.				X	X	X		X					X	
A.F.	X	X	X		X	X		X		X			X	X
A.B.		X		X	X	X		X		X			X	X
S.M.	X		X	X	X	X		X		X			X	X
K.B.			X	X		X		X		X			X	
S.Z.	X			X		X		X			X	X		X
K.S.			X	X		X		X		X	X			X
C.C.				X		X		X					X	
S.O.	X												X	
R.M.	X			X	X	X		X	X	X				
A.W.	X					X		X		X			X	
A.S.	X			X		X		X		X	X		X	X
M.T.	X			X		X		X					X	
E.G.				X		X		X	X	X	X		X	X
M.P.	X	X	X	X	X	X		X		X	X		X	
E.R.	X	X		X		X	X	X		X			X	
K.			X	X				X	X	X	X			
M.				X		X		X		X				
A.	X		X	X	X	X		X	X	X				
C.								X	X	X	X		X	
R.				X	X	X		X	X		X		X	X
M.														
L.			X	X	X	X		X		X	X		X	X
B.								X						
K.	X	X		X		X		X	X		X		X	
J.	X			X		X		X	X	X				X
M.	X		X											
NN					X	X		X	X	X				X
TOTALS	14	5	9	20	10	22	1	25	9	18	10	1	17	11
Percent	50	18	32	71	36	79	4	89	32	64	36	4	61	39

Chart II

PROCESS PROBLEMS

(Some process instruction)

N 19	GUESS & CHECK		DRAW A PICTURE		MAKE A LIST		MAKE A TABLE		WORK BACKWARDS		LOOK FOR A PATTERN		LOGICAL REASONING	
STUDENTS	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
E.O.	X	X		X					X					
S.H.														
T.	X		X											
K.P.	X			X	X		X		X					
C.G.	X		X	X	X	X	X		X	X			X	
No Name 1	X	X					X							
A.B.	X						X							X
NN 2		X		X		X				X				X
L.H.	X	X								X				
C.N.	X												X	
A.T.	X					X								
NN 3	X			X		X				X				
NN 4				X										
T.	X	X					X			X				
NN 5				X										
L.W.	X		X		X		X						X	
Q.T.				X		X				X				
L.H.	X	X												X
K.W.	X													
TOTALS	14	6	3	8	3	5	6	0	3	6	0	0	3	3
Percent	74	32	16	42	16	26	32	0	16	32	0	0	16	16

Chart III

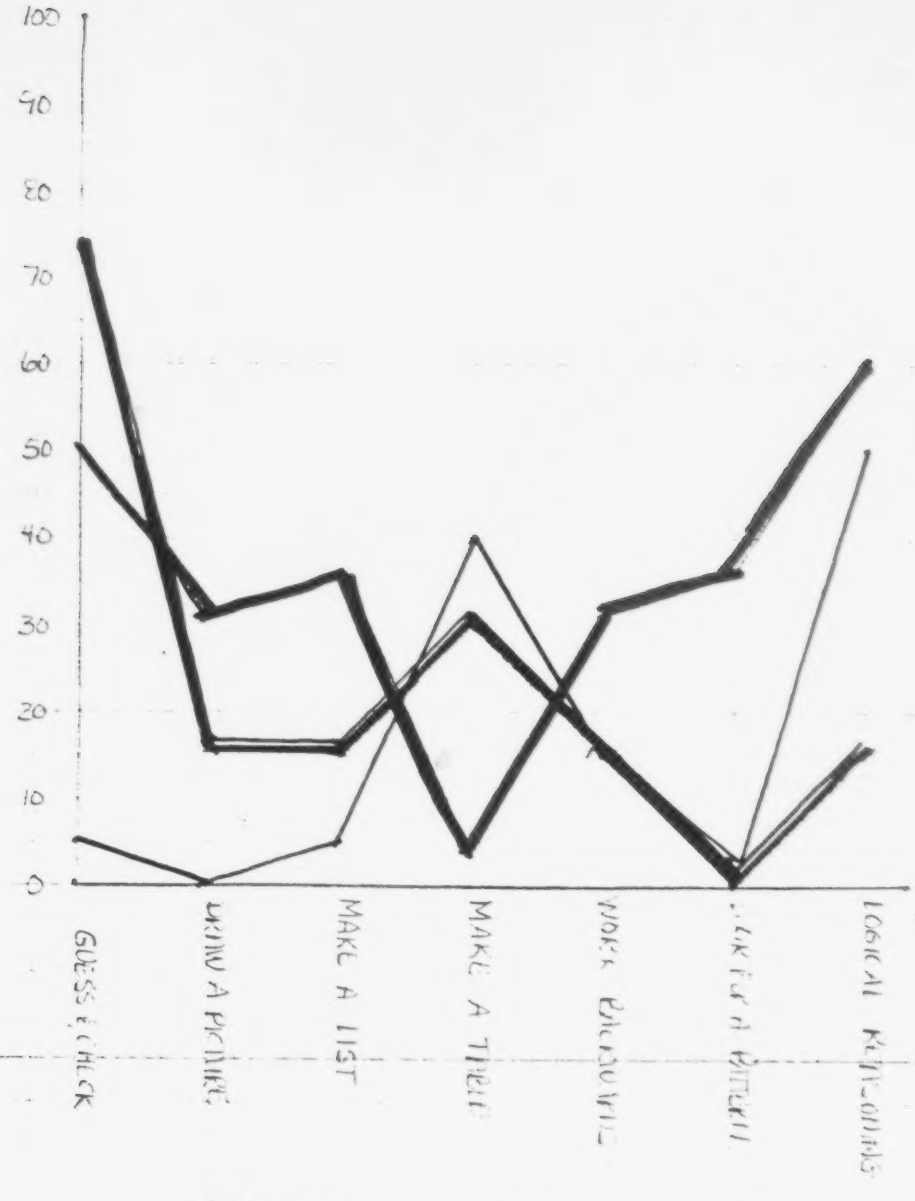
PROCESS PROBLEMS

(No purposeful instruction)

N 20	GUESS & CHECK		DRAW A PICTURE		MAKE A LIST		MAKE A TABLE		WORK BACKWARDS		LOOK FOR A PATTERN		LOGICAL REASONING	
STUDENTS	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test	Pre-Test	Post-Test
R.B.				X		X							X	
D.S.						X	X	X						X
J.W.				X		X								
H.K.													X	
L.A.						X			X				X	
T.G.							X	X						
Q.P.														
D.H.													X	
V.B.							X						X	
T.H.						X								
S.M.					X	X	X						X	X
C.M.				X		X	X		X				X	
S.W.	X			X		X	X						X	X
C.J.						X							X	
L.S.							X							
J.C.				X		X	X		X				X	
N.N.						X								
N.D.				X		X				X				
N.M.				X		X								
M.O.				X										
TOTALS	1	0	0	8	1	13	8	2	3	1	0	0	10	3
Percent	5	0	0	40	5	65	40	10	15	5	0	0	50	15

CHART IV

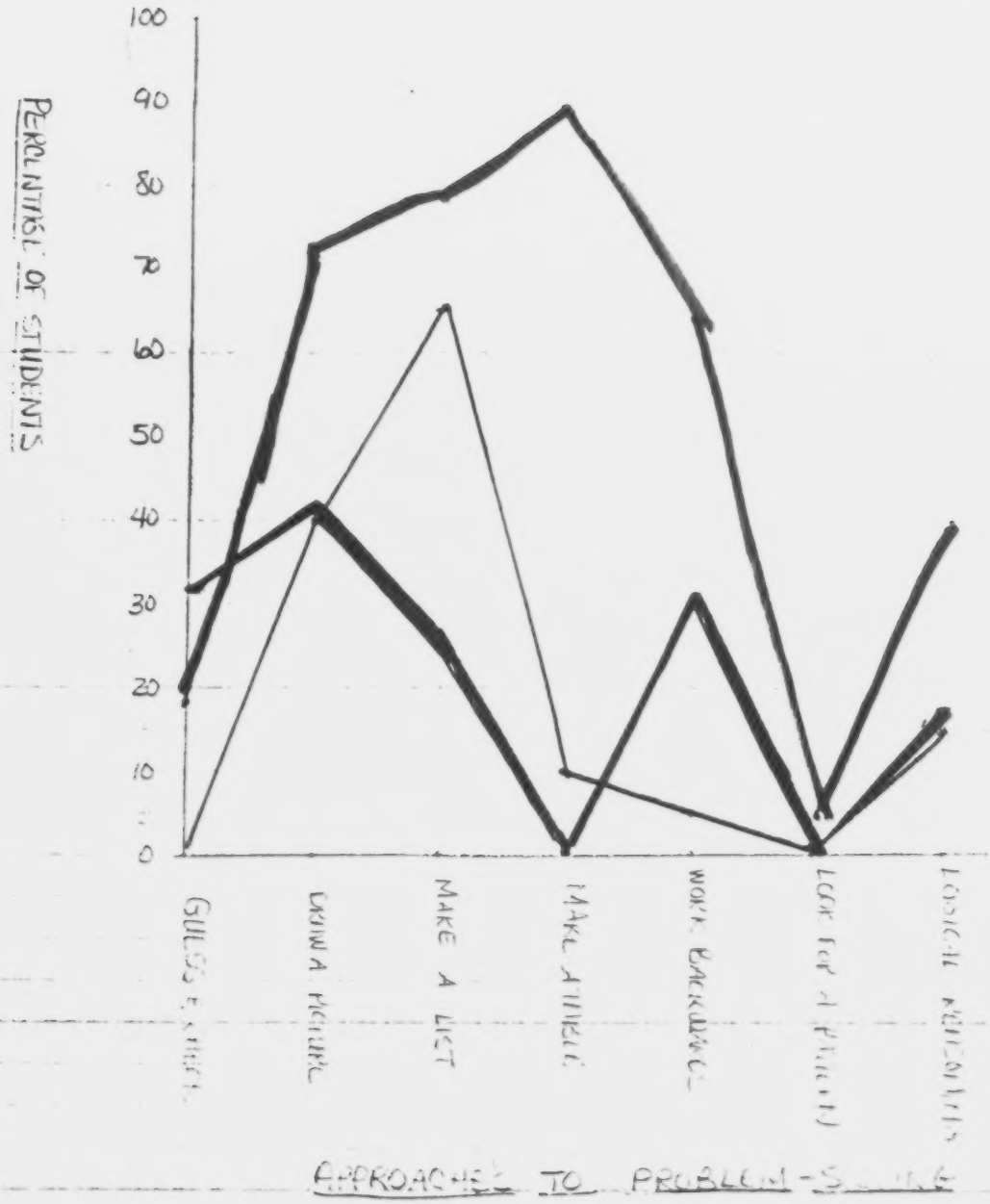
Classroom Comparison: Pre-test Results in Problem Solving



Class Three : no purposeful
Class Two : some
Class One : deliberate

CHART V

Classroom Comparison: Post-test Results in Problem Solving



Class Three : no purpose
Class Two : some purpose
Class One : de[illegible] instruction

CHART VI

CLASS ONE:
PRE/POST TEST RESULTS - USE OF PROBLEM SOLVING STRATEGIES WITH DAILY PURPOSEFUL INSTRUCTION

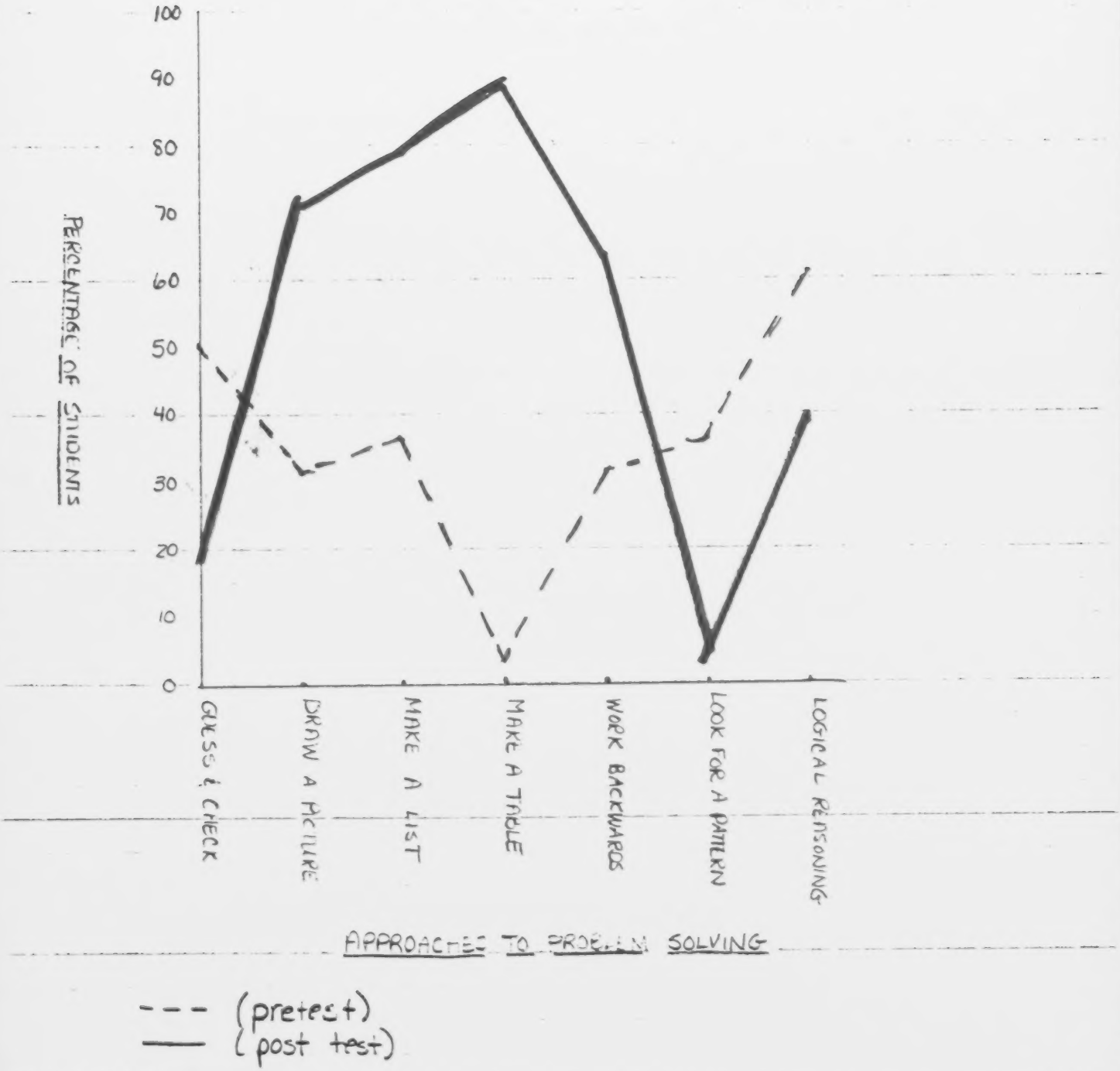


CHART VII

CLASS TWO:

PRE/POST TEST RESULTS - USE OF PROBLEM SOLVING STRATEGIES WITH SOME PURPOSEFUL INSTRUCTION

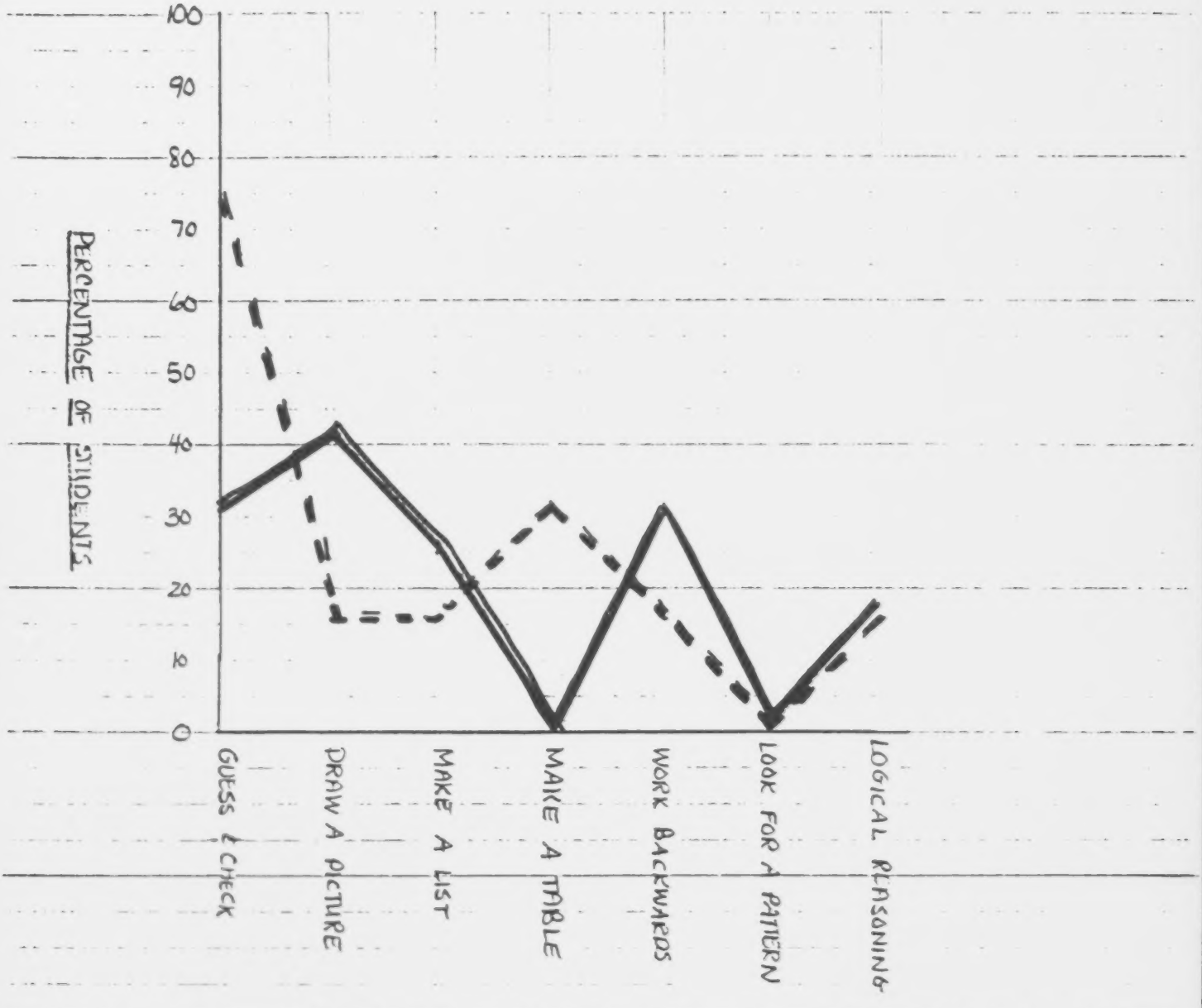
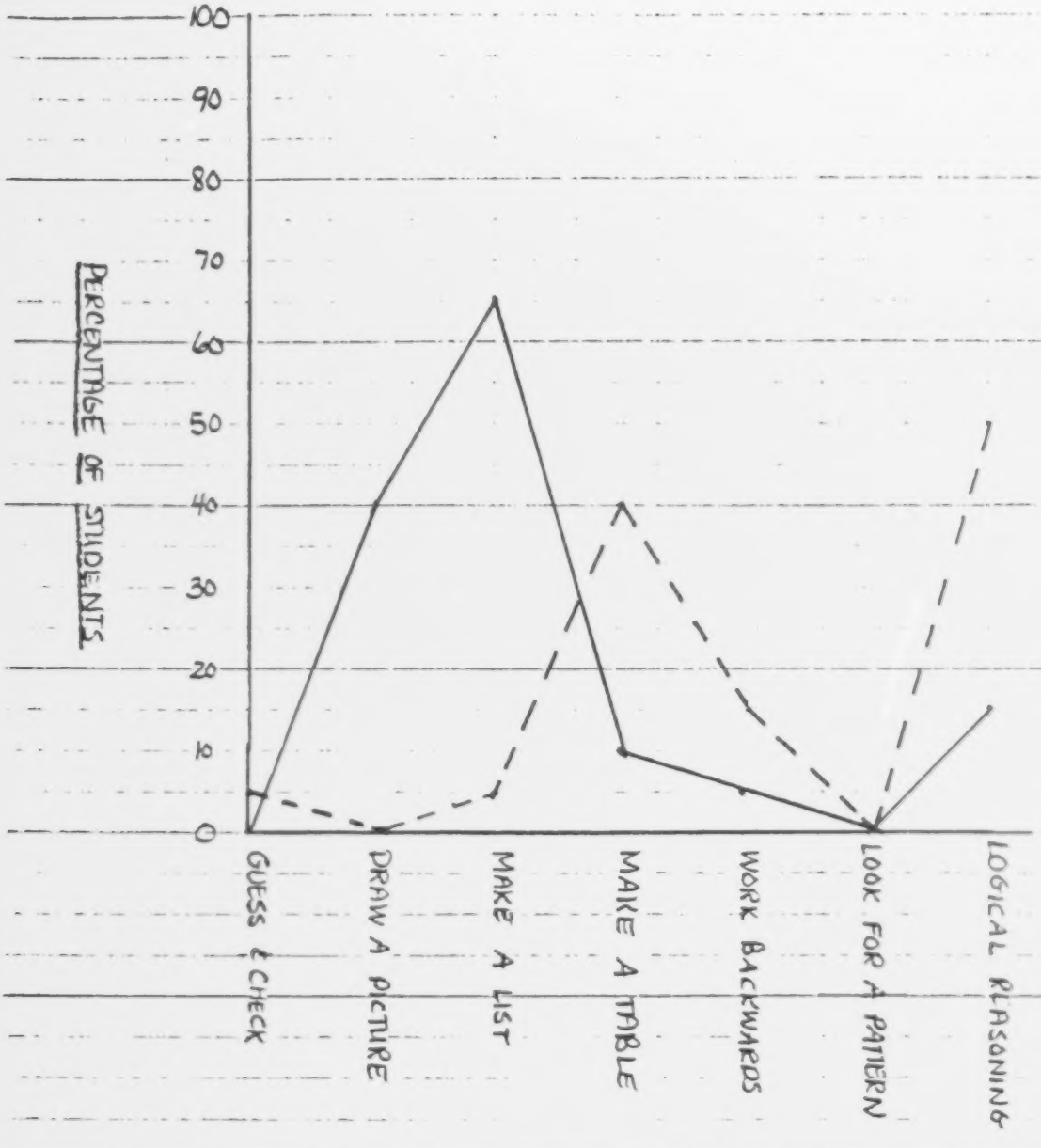


CHART VIII

CLASS THREE:

PRE/POST TEST RESULTS - USE OF PROBLEM SOLVING STRATEGIES WITH NO PURPOSEFUL INSTRUCTION



APPROACHES TO PROBLEM SOLVING

--- (pretest)

—— (post test)